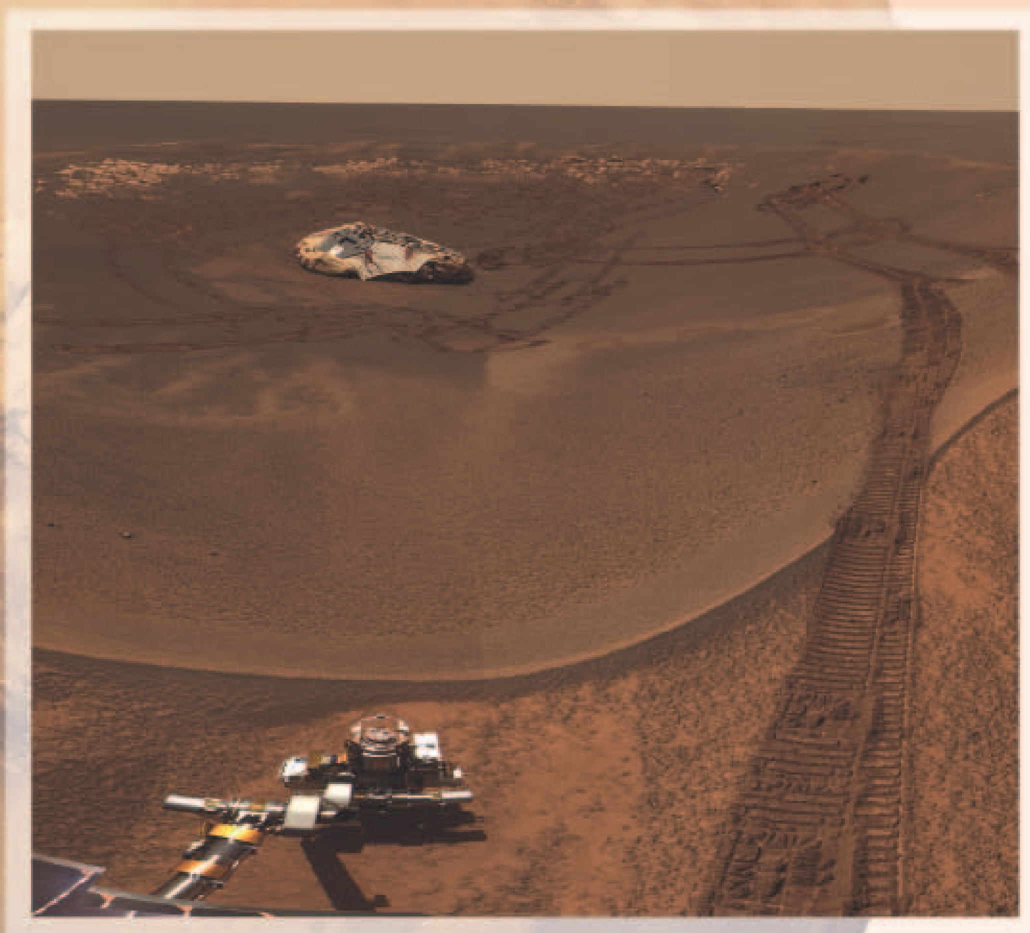
The New Age of Exploration

NASA's Direction for 2005 and Beyond



February 2005

National Aeronautics and Space Administration

NASA'S VISION

To improve life here,
To extend life to there,
To find life beyond.

NASA'S MISSION

To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers
…As only NASA can.

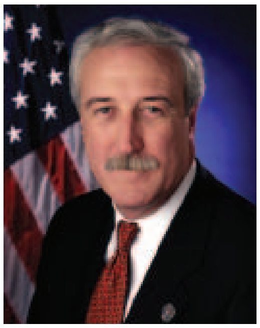
NASA'S VALUES

Safety, the NASA Family, Excellence, and Integrity

Titan's atmosphere glows in blues, reds, and greens in this image taken by Cassini in ultraviolet and infrared wavelengths. The colors reveal a brighter (redder) northern hemisphere. Blue represents ultraviolet wavelengths and shows the high atmosphere and detached hazes.

Tragedy, Triumph, and Transformation

Reflection's from NASA Administrator Sean O'Keefe



President John F. Kennedy said, "All great and honorable actions are accompanied with great difficulties, and both must be enterprised and overcome with answerable courage." As I reflect on my three years at NASA, there have been moments of great tragedy and times of extraordinary triumph. I believe that we have sailed steadily through both, and along the way, we have begun to transform NASA and ourselves to meet the challenges of a new century.

Tragedy and Triumph

In 2003, the loss of Space Shuttle *Columbia* and seven astronauts stunned NASA and the world. The triumphant mission turned to tragedy in moments, and the shock and loss to our Agency were staggering. But, the NASA family was both determined to keep NASA's programs going and committed to returning the grounded Space Shuttle fleet to flight in tribute to our fallen comrades. Even as we mourned, we moved ahead.

In 2004, we made excellent progress in implementing the recommendations of the *Columbia* Accident Investigation Board to return the Space Shuttle safely to flight. We also enjoyed and shared with the world a host of NASA triumphs. Our Mars rovers, *Spirit* and *Opportunity*, found definitive evidence of water on the Red Planet and continue to gather data more than a year after their successful landing. The Cassini–Huygens spacecraft entered Saturn's orbit and sent back breath-taking images of that planet's rings and moons. We launched MESSENGER to visit and map Mercury while our eyes in the sky, including Hubble, Chandra, and Spitzer, continued to amaze us with images from the deepest reaches of space. The X–43 flew nearly 10 times the speed of sound, and we enabled cleaner air, safer flights, and numerous technology transfers to other government agencies and private industry to improve the health, safety, and security of humankind. With our international partners, we made successful expedition missions to the International Space Station, completing four years of continuous human presence, and we added to our constellation of Earth observing satellites that monitor our fragile planet.

But, these triumphs were just the beginning.

The Vision for Space Exploration

On January 14, 2004, President George W. Bush announced *A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration*, a new directive for the Nation's space exploration program. The fundamental goal of this directive is "…to advance U.S. scientific, security, and economic interests through a robust space exploration program." In issuing it, the President committed the Nation to a journey of exploring the solar system and beyond. We will return to the Moon in the next decade, then venture further into the solar system, ultimately sending humans to Mars and beyond. He challenged us to establish new and innovative programs to enhance our understanding of the planets, to ask new questions, and to answer questions that are as old as humankind. Our NASA family enthusiastically embraced this directive and the opportunities it presents. And, we immediately began a long-term transformation that will enable us to achieve this goal.

The *Vision for Space Exploration*, published in February 2004, embodies the strategy and guiding principles we will follow in pursuit of the President's challenge. And, while we have enjoyed many great triumphs during these three years, nothing in my time at NASA makes me more proud than our efforts to transform our Agency and implement the *Vision for Space Exploration*. This Vision defines us as those who seek to improve the human condition by expanding our knowledge and understanding of who we are, where we came from,

Saturn's moon Mimas is seen against the cool, blue-streaked backdrop of Saturn's northern hemisphere in this picture taken by the Cassini spacecraft in November 2004. Shadows cast by the rings streak across the planet.

and where we are going. It is not a random collection of great ideas. It is a plan that lays out fundamental goals of great importance for our Nation, and it embodies a strategy of specific milestones that will move us forward in the years and decades ahead if we are diligent in our pursuits.

In June 2004, the President's Commission on Implementation of the United States Space Exploration Policy (Aldridge Commission) presented its report to the President. The Commission emphasized the crucial role that technological innovation, national and international partnerships, and organizational transformation must play if we are to implement an affordable and sustainable space exploration program successfully. We are committed to making every change necessary to ensure our success.

Transformation

Transforming NASA requires that we take the extraordinary capabilities we have throughout the Agency and restructure them to achieve the goals of the 21st century. This has been a central challenge of our time together, but in less than a year, we have streamlined our Headquarters organization structure and begun transforming our culture to foster permanent change and effect a positive, mission-driven culture throughout the organization. Our senior leaders revalidated NASA's core values—Safety, the NASA Family, Excellence, and Integrity—and, to foster an environment of openness and free-flowing communication, we continue to assess our leadership practices and develop comprehensive individual leader action plans for greater effectiveness throughout. We also are cascading our values, goals, and objectives to every NASA employee through enhanced performance management strategies so the entire NASA family will be focused in the same direction.

The New Age of Exploration: NASA's Direction for 2005 and Beyond

As 2005 begins, our entire NASA family is focused on leading the Nation on a journey into the future with revitalized vigor and energy. The first step in that journey is to return the Space Shuttle to flight, a near-term goal that will enable us to complete assembly of the Space Station, and to move forward in understanding the challenges of long-duration space flight by returning humans to the Moon for an extended stay. From that experience, and all that we will learn, we will advance robotic and human exploration of Mars and other destinations throughout the solar system.

To manage what lies ahead as we implement the *Vision for Space Exploration*, we are making significant, on-going changes to our organization's planning processes. This document, *The New Age of Exploration: NASA's Direction for 2005 and Beyond*, is NASA's commitment to making those changes and to implementing the *Vision for Space Exploration*. *NASA's Direction for 2005 and Beyond* establishes new NASA Strategic Objectives. It aligns with our revised 2006 budget estimates, and we will reflect it in our *FY 2005 Performance and Accountability Report*.

Pending publication of the next NASA Strategic Plan, our Agency direction will be based on the following framework supporting the *Vision for Space Exploration*:

- NASA's overarching Agency goal is the fundamental goal of the *Vision for Space Exploration*—"…to advance U.S. scientific, security, and economic interests through a robust space exploration program."
- We will direct our efforts toward five National Objectives. Four of these come directly from the *Vision for Space Exploration*. The fifth National Objective affirms our continued commitment to understand and protect our home planet, Earth.
- We will pursue 18 long-term NASA Strategic Objectives to which all of our programs and resources will be tied.

Our 2006 NASA Strategic Plan will reflect this framework. It also will be based on a set of strategic and capability roadmaps currently being developed by national teams of experts from academia, industry, other government agencies, and NASA.

Stewards of the Dream

Seventeen billion visits to our Web site over the last year are just one indicator of how interested and supportive the American people are of America's space program. The NASA family is privileged to be the stewards of the people, to explore and discover on their behalf.

When Columbus made his voyages across the Atlantic in the 15th and 16th centuries, his ships carried the inscription, "Following the light of the sun, we left the old world." In our time together, we, too, sailed toward the light of the sun and left the old world behind. As I move on to other challenges, I wish everyone in the NASA family the very best of voyages to come.

NASA is a great organization that is positioned to approach and manage the future, whatever comes. I will continue to follow with pride NASA's journeys in the years to come with a full heart and the knowledge that I am a proud member of the extended NASA family.

Pursuing National Objectives for Space Exploration

NASA's Guiding National Objectives

1. Implement a sustained and affordable human and robotic program to explore the solar system and beyond.
2. Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations.
3. Develop innovative technologies, knowledge, and infrastructure both to explore and to support decisions about the destinations for human exploration.
4. Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.
5. Study the Earth system from space and develop new space-based and related capabilities for this purpose.

Astronaut Nancy Currie participates in a test with Robonaut, NASA's dexterous robotic assistant, to evaluate human–robotic operations. NASA is developing a wide range of autonomous robotics that will conduct surveys in advance of human exploration, offer astronauts an extra set of "hands and eyes," and conduct operations that would be hazardous to humans.

Pursuing National Objectives for Space Exploration

Like the pioneers of flight in the last century, NASA researchers and scientists cannot today identify all that the Nation will gain from space exploration in the future. They are confident, however, that the return on the Nation's investment will be great because the *Vision for Space Exploration* mandates a clear goal: "…to advance U.S. scientific, security, and economic interests through a robust space exploration program."

To ensure that NASA remains focused and achieves this goal, the Agency will direct all efforts and resources toward five National Objectives.

A Human and Robotic Partnership for Exploration

Humans are driven by a quest for profound knowledge: How did the universe and this solar system form? How and where did life begin? How far can humankind extend its reach into the universe? Is there life elsewhere? NASA's search for answers to these questions already has led to extraordinary scientific discoveries and technological breakthroughs that are benefiting humankind as well as the Nation's economy, security, and scientific prestige. These achievements also are fueling the drive to implement a sustained and affordable human and robotic exploration program that will carry explorers across the solar system and beyond.

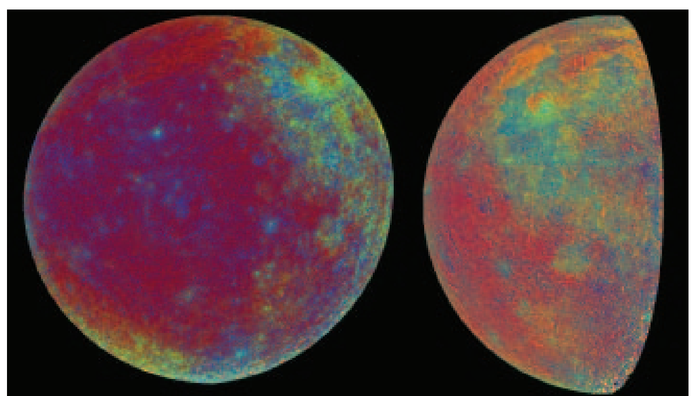
NASA views human and robotic explorers as partners in achieving the goal of the *Vision for Space Exploration*. Over the next three decades, NASA will send robotic missions to the Moon, Mars, the moons of Jupiter, and other planetary bodies in the outer solar system. These robotic explorers will visit new worlds to obtain scientific data, demonstrate technology capabilities, identify space resources, and gather information critical to maintaining the health and productivity of human explorers. Robotic missions also will serve as testbeds for developing and testing the technologies that eventually will carry human explorers beyond low Earth orbit. In short, robots will serve as counterparts to human explorers by offering an extra set of "hands and eyes," providing sensing capabilities that surpass human senses, going where humans cannot go, and bringing the universe back to Earth in the form of stunning images and samples of many kinds.

Human explorers ultimately will follow robotic explorers to elevate capabilities and accelerate discovery. As the President said, "We need to see and examine and touch for ourselves." Human explorers will provide unparalleled dexterity, versatility, breadth of knowledge and experience, and quick, logical decision-making capabilities to augment and complement robotic explorers. They also will serve as a potent symbol of American democracy, a reminder of what the human spirit can achieve in a free society.

To the Moon, Mars, and Beyond

Earth's closest planetary neighbor, the Moon, offers a wealth of important scientific data and a unique record of the early evolution of the solar system's terrestrial planets and near-Earth cosmic environments that existed during the first billion years of the solar system's history. This record is invaluable for reconstructing the period when the planets were formed. More important, by going to the Moon for extended periods of time, astronauts will learn how to work safely in an environment with low gravity, extreme temperatures, radiation, the absence of breathable air, and other conditions as a stepping stone to future planetary and space exploration. Explorers also will determine if the Moon can provide resources for sustained space exploration.

Recent robotic missions, including the Mars exploration rovers, *Spirit* and *Opportunity*, found evidence that Mars once had oceans and rivers of water—liquid water that might still exist in deep reservoirs. This evidence of water suggests that simple forms of life may have developed early in Mars' history and may persist beneath the surface today. Human exploration of Mars, including detailed geologic investigations, will enhance NASA's ability to achieve a key Agency mission: to search for life beyond Earth.



These false-color visualizations of the Moon taken by the Galileo spacecraft in 1990 depict the spectral properties of the lunar surface. The deeper blues show areas that are relatively rich in titanium, while the greens, yellows and light oranges indicate basalts low in titanium but rich in iron and magnesium. The reds (deep orange in the right hand picture) are typically cratered highlands relatively poor in titanium, iron and magnesium. NASA will conduct extensive surveys of the Moon to locate resources and determine the best landing sites for other robotic or human surface missions.

Challenging Technology Innovation

The Apollo, Space Shuttle, and International Space Station programs identified technical challenges to long-duration space exploration that must be overcome through new technologies that support reasoned decision-making about future exploration destinations and the feasibility, methodologies, and risks associated with space exploration. New technologies must ensure that subsystems are reusable and modular, require less ground support and infrastructure, and be compatible with enhanced in-space assembly and repair capabilities. These innovative technologies will include robotic networks that can work cooperatively, cost-effective power generators for long duration missions, enhanced space communication technologies that address the needs of spacecraft operating in both near-Earth and deep-space regions, and methodologies for achieving precise, reliable, and global access to the Moon and other destinations from orbit and from other planetary surfaces through the use of advanced mobility systems.

Promoting Partnerships

Exploration and discovery fuel economic, social, and intellectual growth and accelerate the development of science and technologies that are important to the world's economy and national security. Partnerships provide opportunities to leverage resources. They create venues for research and technology to be matured and transferred to government and private entrepreneurs, and they provide unparalleled educational opportunities. Together, NASA and the Agency's partners can accomplish more than any one entity could achieve alone.

NASA has a long history of collaboration with the space and research agencies of other nations. The International Space Station draws on the resources and scientific and engineering expertise of 16 nations. Since the Space Shuttle was grounded after the *Columbia* accident in February 2003, automated Russian Progress vehicles have re-supplied the two-person Station crew as needed, and Russian Soyuz vehicles have transported crews safely and reliably to and from the Station. A similarly extraordinary international partnership with Europe contributed to the success of the Cassini–Huygens mission to Saturn, and the SOHO mission to observe the Sun. In fact, nearly all NASA Earth observing missions include substantial international participation. For example, the Global Earth Observation System of Systems includes over 50 nations and more than 30 international research and environmental forecasting organizations. And, NASA also participates actively in international groups like the International Civil Aviation Organization, which develops global policies governing commercial flight.

NASA's partnerships with other government agencies have advanced science and research and ensured that technologies emanating from NASA's work are transferred to organizations that can use them for the benefit of all. From sharing NASA satellite air quality data with the Environmental Protection Agency, developing new technologies for safer flight with the Federal Aviation Administration, identifying biological contaminants for the Department of Homeland Security, to sharing information and leveraging resources with the Department of Defense, NASA is a full Federal partner in exploration and discovery initiatives. State and local governments, too, rely on and support NASA's work, perhaps most prominently in education and environmental improvements. NASA continues to seek opportunities to establish new government partnerships while maintaining existing alliances.

NASA also has a long history of working with the Nation's education community at all levels. From awarding grants, supporting fellowships and university research consortia, and conducting research at the Nation's top universities to engaging the next generation of explorers and researchers in mathematics and science classrooms everywhere, NASA provides scientific content, advanced technological tools, and supplemental educational services as part of an education pipeline that extends from elementary through secondary education and beyond. NASA also partners with national, state, and local teacher and education associations and Boards of Education to meet the needs of teachers and students.

NASA's partnerships with industry have resulted in many of the discoveries and milestones in NASA's history. While NASA benefits from the expertise, materials, and components provided by large and small companies, the Agency's partner industries benefit economically from collaborating with NASA. Industrial partnerships also encourage healthy competition, demonstrate and enhance the appropriate role of the Federal government, and often provide economic benefits to small and disadvantaged businesses.

Focusing On Earth

Throughout the last several decades, NASA has used space technology to understand Earth, the Sun, and the powerful links between the two. Using space-based observations, the Agency provided essential data enabling scientists to learn how the El Niño–La Niña cycle works, gain new insights into Antarctic ozone depletion, track the dramatic decrease in sea ice cover in Earth's Arctic region, and characterize the present state of the Earth–Sun system. Having pioneered space-based remote sensing, NASA and its partners recently completed deployment of the first comprehensive Earth Observing System, and NASA's goal is to continue using the view from space to study the Earth system and improve prediction of Earth system changes.

NASA will develop new space-based technology to monitor the major interactions of the land, oceans, atmosphere, ice, and life that comprise the Earth system. In the years ahead, NASA's fleet will evolve into human-made constellations of smart satellites that can be reconfigured based on the changing needs of science and technology. From there, researchers envision an intelligent and integrated observation network comprised of sensors deployed to vantage points from the Earth's subsurface to deep space. This "sensorweb" will provide timely, on-demand data and analysis to users who can enable practical benefits for scientific research, national policymaking, economic growth, natural hazard mitigation, and the exploration of other planets in this solar system and beyond.

Charting a New Course

NASA STRATEGIC OBJECTIVES FOR 2005 AND BEYOND

1. Undertake robotic and human lunar exploration to further science and to develop and test new approaches, technologies, and systems to enable and support sustained human and robotic exploration of Mars and more distant destinations. The first robotic mission will be no later than 2008.
2. Conduct robotic exploration of Mars to search for evidence of life, to understand the history of the solar system, and to prepare for future human exploration.
3. Conduct robotic exploration across the solar system for scientific purposes and to support human exploration. In particular, explore the moons of Jupiter, asteroids, and other bodies to search for evidence of life, to understand the history of the solar system, and to search for resources.
4. Conduct advanced telescope searches for Earth-like planets and habitable environments around the stars.
5. Explore the universe to understand its origin, structure, evolution, and destiny.
6. Return the Space Shuttle to flight and focus its use on completion of the International Space Station, complete assembly of the ISS, and retire the Space Shuttle in 2010, following completion of its role in ISS assembly. Conduct ISS activities consistent with U.S. obligations to ISS partners.
7. Develop a new crew exploration vehicle to provide crew transportation for missions beyond low Earth orbit. First test flight to be by the end of this decade, with operational capability for human exploration no later than 2014.
8. Focus research and use of the ISS on supporting space exploration goals, with emphasis on understanding how the space environment affects human health and capabilities, and developing countermeasures.
9. Conduct the first extended human expedition to the lunar surface as early as 2015, but no later than 2020.
10. Conduct human expeditions to Mars after acquiring adequate knowledge about the planet using robotic missions and after successfully demonstrating sustained human exploration missions to the Moon.
11. Develop and demonstrate power generation, propulsion, life support, and other key capabilities required to support more distant, more capable, and/or longer duration human and robotic exploration of Mars and other destinations.
12. Provide advanced aeronautical technologies to meet the challenges of next generation systems in aviation, for civilian and scientific purposes, in our atmosphere and in atmospheres of other worlds.
13. Use NASA missions and other activities to inspire and motivate the Nation's students and teachers, to engage and educate the public, and to advance the scientific and technological capabilities of the nation.
14. Advance scientific knowledge of the Earth system through space-based observation, assimilation of new observations, and development and deployment of enabling technologies, systems, and capabilities, including those with the potential to improve future operational systems.
15. Explore the Sun–Earth system to understand the Sun and its effects on Earth, the solar system, and the space environmental conditions that will be experienced by human explorers, and demonstrate technologies that can improve future operational systems.
16. Pursue opportunities for international participation to support U.S. space exploration goals.
17. Pursue commercial opportunities for providing transportation and other services supporting International Space Station and exploration missions beyond Earth orbit. Separate to the maximum extent practical crew from cargo.
18. Use U.S. commercial space capabilities and services to fulfill NASA requirements to the maximum extent practical and continue to involve, or increase the involvement of, the U.S. private sector in design and development of space systems.

Charting a New Course

This generation inherited great legacies from the exploratory voyages and discoveries of earlier centuries, and NASA's success in achieving the *Vision for Space Exploration* will bequeath to future generations a similar legacy of achievement and inspiration. Because the purpose of exploration is to understand the unknown, the precise benefits of space exploration defy calculation, and planning must remain fluid and dynamic to adapt to exciting diversions and new directions. To ensure that NASA pursues the *Vision for Space Exploration* in a systematic, yet flexible manner, the Agency has established 18 NASA Strategic Objectives to guide the Agency's course in 2005 and beyond. The first 15 are related directly to NASA program initiatives, and a specific Mission Directorate will champion each. The final three are cross-cutting support objectives. They do not have unique performance measures or budgets. However, their successful achievement is critical to NASA's achievement of the *Vision for Space Exploration*.

Strategic Objective 1: Undertake robotic and human lunar exploration to further science and to develop and test new approaches, technologies, and systems to enable and support sustained human and robotic exploration of Mars and more distant destinations. The first robotic mission will be no later than 2008.

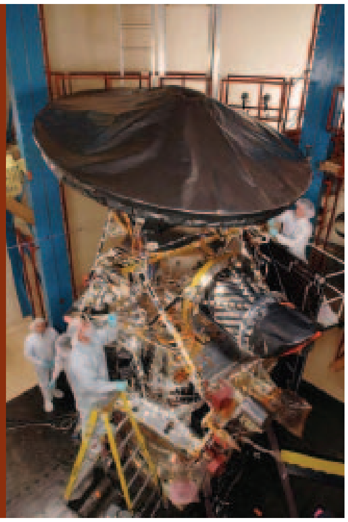
As a stepping-stone to Mars and beyond, NASA's first destination for robotic and human exploration is the Moon. Only a few days from Earth, the Moon contains a 4.5 billion-year record of the origin of the Earth-Moon system and the processes that formed the inner planets. It also provides a convenient location in which to develop and test a variety of exploration tools and techniques. NASA will advance lunar science and use the Moon to: test and develop hardware, software, and various systems and components to determine how they operate in harsh lunar and space environments; provide the opportunity to understand how crews adapt and perform in a partial-gravity environment; test the autonomy of essential systems before they are deployed to more distant destinations; test and enhance interactions between human explorers and robots; and explore the possibility of using resources already present on the Moon for power generation, propulsion, and life support. NASA will begin its lunar research and testbed program with a series of robotic missions beginning with a Lunar Reconnaissance Orbiter to be launched in 2008.

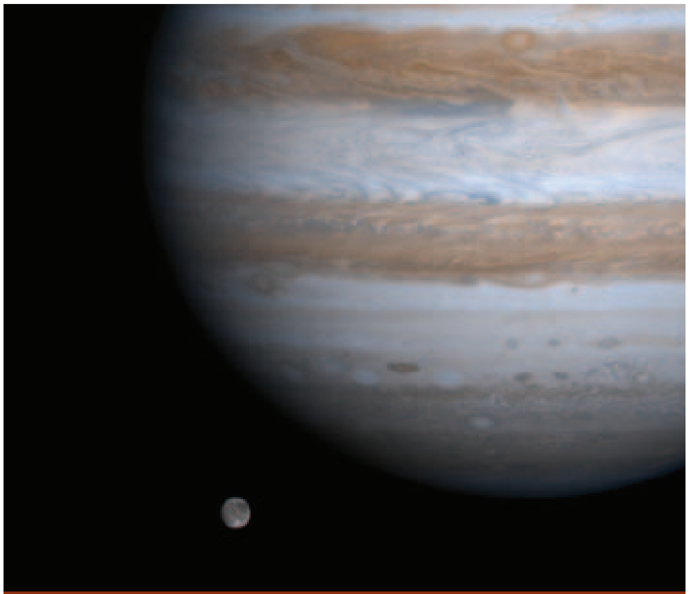
Strategic Objective 2: Conduct robotic exploration of Mars to search for evidence of life, to understand the history of the solar system, and to prepare for future human exploration.

The presence of liquid water is the key to the presence of life beyond Earth. The Mars Exploration Rovers, *Spirit* and *Opportunity*, recently found evidence that water had been present on the Red Planet—in the rocks and soil on the floor of Gusev crater and in standing pools of water that once existed in Meridiani Planum. Based on these discoveries, NASA will pursue the search for water and life on Mars aggressively. NASA's robotic explorers will discern the evolution of Mars and characterize the Red Planet, including its past and present geology, interior, climate, environment, and its biological potential. From this information, NASA will determine the habitability of Mars and determine whether it has ever harbored life.

NASA's exploration of Mars involves a methodical succession of orbiting and surface laboratories over the next two decades in preparation for future human missions. The Mars Global Surveyor and Mars Odyssey, two currently operational orbiters, have improved estimates of the abundance of water within the uppermost surface layer, atmosphere, and icecaps of Mars. Odyssey is measuring the galactic cosmic radiation background from Mars's orbit, and it is likely that solar and cosmic radiation measurements will be conducted from the Mars surface later in the decade. The Mars Reconnaissance Orbiter, to be launched this year, will use subsurface sounding radar to search below the surface of Mars for evidence of water. The Orbiter also will characterize atmospheric processes over a full Mars year and provide

Crews work on the Mars Reconnaissance Orbiter, which is scheduled to launch in summer 2005. In this photo, taken in January 2005, the Orbiter has already been fitted with five of its six primary science instruments, both solar arrays, and its high-gain antenna. The Orbiter will begin a series of global mapping, regional survey, and targeted observations from a near-polar, low-altitude orbit, analyzing minerals and searching the shallow subsurface for water.





The solar system's largest moon, Ganymede, is shown alongside Jupiter in this picture taken by the Cassini spacecraft in 2000. Cassini arrived at its primary target, Saturn, in 2004.

the first definitive measurements of local mineralogy in the search for possible habitats for life.

In 2007, the Phoenix Mars Scout mission will land at Mars' ice-rich northern latitudes to measure climate, chemistry, and organics. Subsequently, the 2009 Mars Science Laboratory will start a series of missions to explore a vast terrain on Mars' surface for evidence of organic materials and other signatures of past and present life, returning samples for study in Earth laboratories. By the end of the next decade, NASA will have a complete inventory of critical environmental parameters, local hazards, and potential resources to support future human exploration of Mars.

Strategic Objective 3: Conduct robotic exploration across the solar system for scientific purposes and to support human exploration. In particular, explore the moons of Jupiter, asteroids, and other bodies to search for evidence of life, to understand the history of the solar system, and to search for resources.

In the coming decades, spacecraft will fan out to destinations from the innermost planets to the edge of the Sun's influence to learn more about the history of the solar system and search for signs of life and usable resources. NASA's Discovery Program will continue to support highly focused missions that are a key element of the Agency's current and future exploration program. Discovery Program missions have included: the Mars Pathfinder and Lunar Prospector missions; the recent Genesis mission that returned samples of solar winds to Earth; and the MESSENGER mission launched in August 2004 to conduct a comprehensive geological, geophysical, and geochemical survey of Mercury. The Deep Impact mission will investigate volatile and organic materials in the deep interior of a short-period comet to determine if comets might have transported water to Earth from the outer reaches of our solar system. Stardust—a longer-term Discovery mission—will return comet dust samples to Earth in 2006, and Dawn will visit the two largest asteroids to shed light on the formation of the solar system.

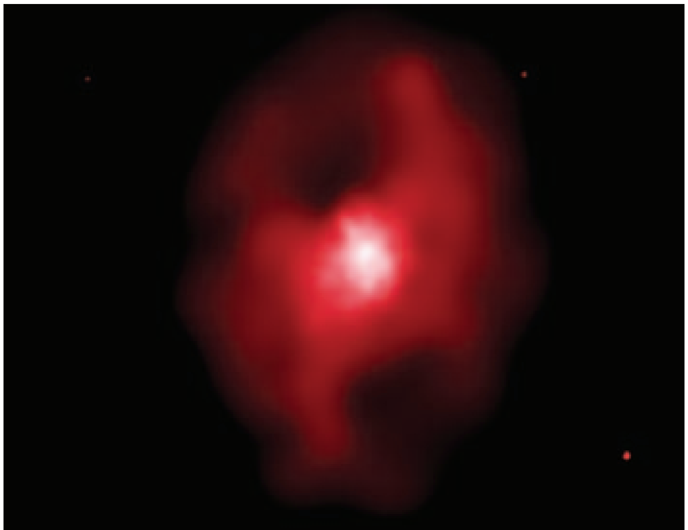
Other missions are long-term and more complex, such as long-duration exploration of the outer planets and their moons. The twin Voyager spacecraft and Galileo found evidence that planet-wide oceans likely lie beneath the icy surfaces of Jupiter's moons, particularly Europa, suggesting that life could have developed—and might still exist—on one or more of these moons today. The exploration of Europa was identified as the highest "flagship" mission in the National Research Council's 2003 solar system decadal study, *New Frontiers in the Solar System: An Integrated Exploration Strategy*.

As part of the New Frontiers program, a mission to Pluto in 2006 will examine the Pluto–Charon system and Kuiper Belt, which may retain the best records of the materials present in the original solar nebula. The planets, moons, and ancient icy bodies that reside far from the Sun are thought to be a repository of relatively pristine materials from this time and, therefore, hold keys that can help unlock the mysteries of the solar system's origins.

Strategic Objective 4: Conduct advanced telescope searches for Earth-like planets and habitable environments around the stars.

Thanks to NASA's eyes in the sky, including Hubble, Chandra, and Spitzer, over the past decade, astronomers discovered and documented well over 100 extra-solar planets, new worlds, and the discovery that the Sun is not the only star anchoring a solar system, giant steps forward in the search for extraterrestrial life. Within this decade, NASA will launch powerful space-based telescopes that can infer the presence of newly-formed planets circling young stars, count the planets around thousands of far-off stars, and detect planets just a few times larger than Earth orbiting nearby stars. The Space Interferometry Mission will be capable of detecting and measuring the mass of near Earth-sized planetary bodies orbiting nearby stars. The Kepler mission, planned for launch in 2007, will provide the first opportunity to learn how common it is for a star to have an orbiting Earth-sized planet. And, the James Webb Space Telescope, a large, infrared telescope, will be launched in 2011 to study the earliest galaxies and stars.

The results from these telescopes will be factored into the design of an advanced space telescope, the Terrestrial Planet Finder, to be launched in the next decade. The Terrestrial Planet Finder will be capable of finding Earth-like planets and detecting the chemical composition of their atmospheres. If NASA finds terrestrial planets orbiting nearby stars, the Agency can tackle two even more ambitious objectives: determining which planets have conditions suitable for life and which, if any, show actual signs of past or present life.



This Chandra image shows two vast cavities, each 600,000 light years in diameter, in the hot, X-ray emitting gas that pervades the galaxy cluster MS 0735. The cavities appear on opposite sides of a large galaxy at the center of the cluster, which indicates that a gigantic eruption produced by the galaxy's supermassive black hole created the structures. The next generation of X-ray observatories will be far more powerful than Chandra, revealing structuers in the universe that are currently hidden.

Strategic Objective 5: Explore the universe to understand its origin, structure, evolution, and destiny.

In their attempts to understand how space, time, and matter are connected, Albert Einstein and his successors made three predictions based on their research. First, space is expanding from a "Big Bang." Second, space and time can tie themselves into contorted knots called "Black Holes" where time actually comes to a halt. And, third, space itself contains some kind of energy that is pulling the universe apart. Today, scientists strongly believe that all three are true. Still, Einstein's theories raised more confounding questions: What powered the "Big Bang"? What happens to space, time, and matter at the edge of a black hole? And, what is the mysterious dark energy that is pulling the universe apart? NASA researchers are leading the way to answering these compelling questions.

Gravity Probe B, launched in 2004, is testing Einstein's prediction that the rotation of the Earth drags space and time around the Earth into a mild version of the tremendous vertical spin near a spinning black hole. The Swift Explorer, also launched in 2004, will study gamma ray bursts believed to result from the stellar explosions and mergers that create black holes. And, the Gamma-ray Large Area Space Telescope (GLAST) will measure gamma rays emitted by a variety of energetic objects like quasars, galaxies in which large quantities of gas are falling onto a super-massive black hole that occupies the galaxy center, releasing huge amounts of gravitational energy. GLAST will map the sky in one day—a task that previously took one year to complete.

As part of NASA's Beyond Einstein program, a pair of great observatories will blaze new paths to answer old questions about black holes, the "Big Bang," and dark energy. First, the Laser Interferometer Space Antenna will probe space and time at the forming edges of black holes by listening to the sounds of vibrating space-time. It will measure gravitational radiation generated by a variety of astrophysical phenomena, including the effect of dark energy on the universe. Next, Constellation X (with 100 times the sensitivity of the Chandra X-ray Observatory) will measure X-ray light resulting from the motions of the plasma and distortions of space and time near the black hole. It will reveal the nature of dark matter and dark energy by observing their effects on the formation of clusters of galaxies. In addition, a number of medium-size missions will focus on understanding dark energy, dark matter, and the cosmic background.

Strategic Objective 6: Return the Space Shuttle to flight and focus its use on completion of the International Space Station, complete assembly of the ISS, and retire the Space Shuttle in 2010, following completion of its role in ISS assembly. Conduct ISS activities consistent with U.S. obligations to ISS partners.

The Space Shuttle's chief purpose over the next several years will be to support assembly of the International Space Station.

Space Shuttle *Discovery* is being readied for return to flight this year, and all three orbiters are going through processing at NASA's Kennedy Space Center where enhanced safety modifications are being made to the Shuttle's external tanks and Thermal Protection Systems. When *Discovery* lifts off, it will have a new multi-functional electronic display system, also called a "glass cockpit," and enhanced vehicle monitoring during flight, including 88 wing leading-edge sensors to monitor acceleration, impact, and temperature, and a digital

Crews slowly moved an External Tank into the awaiting arms of a transporter in the Vehicle Assembly Building at Kennedy Space Center in October 2004. The Tank then was transferred to NASA's Michoud Assembly Facility in New Orleans, where its foam was replaced with an improved bipod fitting. Afterward, the External Tank was returned to Kennedy, where it waits for return to flight.

camera to document the external tank as it separates from the Shuttle.

The International Space Station is the largest international cooperative science and technology project in which the United States has been involved. When complete, it will support robust research by all partner nations through at least 2016. NASA will complete assembly of the International Space Station by the end of the decade. The Agency is examining configurations for the Space Station that meet the needs of both the *Vision for Space Exploration* and NASA's international partners using as few Shuttle flights as possible. This assessment is critical to allowing NASA to continue work on Space Station assembly safely and retire the Shuttle as planned to make way for the Crew Exploration Vehicle (CEV).

In 2010, the Space Shuttle—after nearly 30 years of service—will be retired.

Strategic Objective 7: Develop a new crew exploration vehicle to provide crew transportation for missions beyond low Earth orbit. First test flight to be by the end of this decade, with operational capability for human exploration no later than 2014.

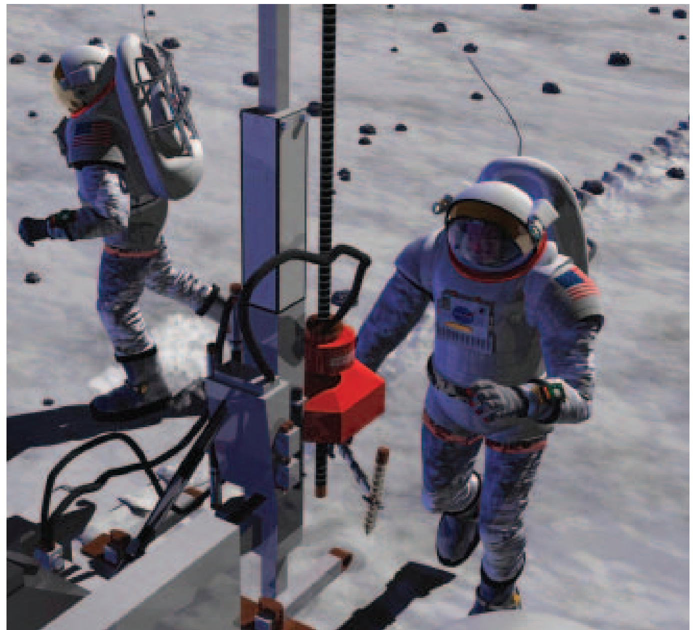
NASA will develop a new CEV to transport crews beyond low Earth orbit and back again. The CEV will be designed to serve multiple functions and operate in a variety of environments. The overall crew transportation system that will evolve from the basic CEV design will enable ascent and re-entry into Earth's atmosphere, Earth orbit, transit to deep space, and operations at the Moon, Mars, or other exploration sites. Initial high-level milestones for this project include, a CEV demonstration flight in 2008 to validate key CEV systems and subsystems, a CEV flight without crew in 2011, and a CEV flight with crew in 2014.


Expedition 10 Commander and Science Officer Leroy Chiao exercises with the short bar for the Interim Resistive Exercise Device to help maintain his upper body strength. NASA is using the Station to develop and test countermeasures, such as exercise techniques, to keep astronauts healthy during long-duration space flight.

Strategic Objective 8: Focus research and use of the ISS on supporting space exploration goals, with emphasis on understanding how the space environment affects human health and capabilities, and developing countermeasures.

After the Space Shuttle returns to flight and major research facilities are delivered to the International Space Station, the Station will emerge as a unique platform for conducting experiments related to human health and performance and developing and testing life support technologies. Larger Station crews will enable a greater range and frequency of operations. NASA will test countermeasures to compensate for the effects of space on human physiology, and astronauts will use the Station to practice autonomous medical care that will be essential for human exploration far from Earth. At the same time, NASA will use the Station to evaluate the performance in microgravity of selected new components, subsystems, and systems necessary for advanced life support.

By 2008, researchers will conduct ground- and flight-based studies that support the development of measures to prevent or minimize microgravity-induced bone loss and muscle atrophy. NASA research on radiation will focus on establishing acceptable levels of risk to crew members, improving the models used to predict radiation levels and effects, and developing implementation strategies for operational countermeasures, including radiation shielding, nutritional supplements, and pharmacological intervention. By 2008, NASA will reduce the uncertainties in estimating radiation risk by one-half and demonstrate the feasibility of radiation-shielding multifunctional structures. In addition, NASA will develop advanced life support systems with reduced size, weight, and complexity that require less power and can save consumables. The Agency also will develop advanced extra-vehicular activity systems, including a protective suit optimized for use on planetary surfaces. By 2010, NASA will identify, develop, and test technologies to reduce total mass requirements for life support systems. The Agency also will devel-


Astronauts use drilling equipment in this artist concept of future lunar exploration. The ability to use in-situ resources is a key capability for future human lunar and planetary missions.

op by 2010 systems to enable production of life support consumables from simulated available resources.

Strategic Objective 9: Conduct the first extended human expedition to the lunar surface as early as 2015, but no later than 2020.

NASA will return humans to the Moon by developing the technological capabilities necessary to sustain extended human space exploration. These capabilities include the critical system-of-systems that will encompass robotic orbiters and rovers, crew transportation, cargo transportation, surface exploration vehicles, in-space and ground support, and other technologies. The development process will include a wide range of technology and systems demonstrations, therefore NASA is using a competitive process with industry-led teams submitting proposals to develop and test different concepts.

Strategic Objective 10: Conduct human expeditions to Mars after acquiring adequate knowledge about the planet using robotic missions and after successfully demonstrating sustained human exploration missions to the Moon.

NASA will determine when to conduct the first human mission to Mars based on numerous criteria, including: discoveries from robotic Mars missions and long-duration human exploration of the Moon; technology readiness (e.g., utilization of in-situ resources, demonstrations of habitat prototypes, improved in-space assembly and repair capabilities, and extended power generation); the ability to sustain healthy, productive crews in the hazardous Martian environment; and available resources. In addition, NASA will consider the effectiveness and readiness of ground/surface operations and supporting systems prior to conducting a human expedition to Mars.

Exploration of other planets may involve winged flight vehicles, such as this Mars flyer concept, to bridge the capabilities gap between orbital and surface vehicles. NASA is researching how to design vehicles that operate in different and unique environments.

Tucked under the wing of NASA's B–52B aircraft, the X–43 hypersonic research vehicle performed a captive carry evaluation flight on September 27, 2004. It is powered by a revolutionary supersonic-combustion ramjet, or "scramjet." Inset: The X–43's rocket ignited moments after release from the B–52B, setting the vehicle on a record-setting flight where it reached nearly Mach 9.8 (7,000 miles an hour). NASA is developing scramjet technology to carry vehicles from Earth to orbit without the heavy oxygen tanks carried by currently-used launch vehicles. Credit: large photo, T. Tschida.

Strategic Objective 11: Develop and demonstrate power generation, propulsion, life support, and other key capabilities required to support more distant, more capable, and/or longer duration human and robotic exploration of Mars and other destinations.

NASA will transform the Agency's space exploration capabilities by investing resources in technical challenge areas, including high-energy power and propulsion; in-space transportation; advanced telescopes and observatories; communication and navigation; robotic access to planetary surfaces; human planetary landing systems; human health and support systems; human exploration systems and mobility; autonomous systems and robotics; transformational spaceport/range; scientific instruments/sensors; in-situ resource utilization; advanced modeling, simulation, and analysis; systems engineering cost/risk analysis; and nanotechnology.

A major focus of NASA's current research is in-space use of nuclear power to meet the higher power needs of future missions. NASA and the Department of Energy are advancing NASA's nuclear systems program, Project Prometheus, cooperatively. NASA researchers hope that enhanced power systems will enable future spacecraft to use instruments of greater sensitivity and resolution than those carried on other missions to distant planets. These advanced instruments would include high-powered radar to penetrate deep into the sub-surfaces of planets and moons, more capable cameras to map entire moons, and laser technology to measure topography. Once proven for in-space use, these nuclear systems also would be used to supply power, and perhaps propulsion, that would reduce travel time to the Moon and other planets.

Educator astronaut Barbara Morgan interacts with students at an Explorer School. Educator astronauts are the direct link between NASA and students, sharing the excitement of discovery with the next generation of scientists, engineers, and explorers.

These same nuclear technologies also would provide energy sources for tools, instruments, and lunar and planetary surface roving vehicles to enable extended human and robotic operations.

Strategic Objective 12: Provide advanced aeronautical technologies to meet the challenges of next generation systems in aviation, for civilian and scientific purposes, in our atmosphere and in atmospheres of other worlds.

For almost 80 years, NASA and its predecessor agency have helped define today's aircraft and promote the rapid growth of aviation through innovation and advanced technology. Today, air transportation is crucial to the Nation's economic health, national security, and overall quality of life, but the U.S. air transportation system is reaching the limits of its capacity and facing new challenges in maintaining safety, security, and a healthy environment. To overcome these problems, NASA is pursuing advanced technologies that will increase air system safety and security, reduce aircraft noise and emissions, and increase the capacity and efficiency of the National Airspace System.

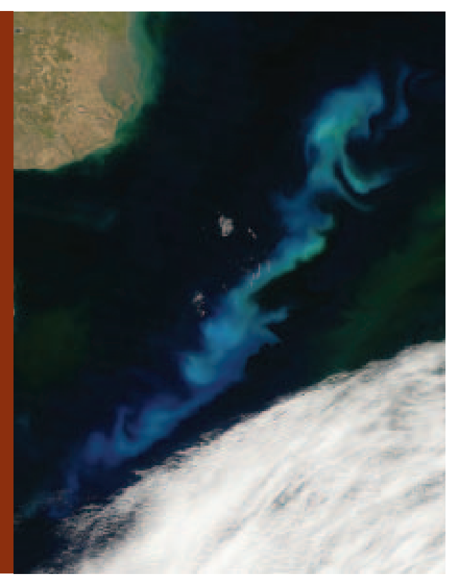
Compared to the 1997 baseline, NASA's technology innovation goals in aeronautics will enable significant improvements in aviation over the next several years: a 70-percent reduction in the aircraft fatal accident rate by 2010; doubling the National Airspace System's capacity by 2009; and a 10-decibel reduction in aircraft noise by 2009. NASA technologies also will reduce the National Airspace System vulnerability by 35 percent compared to 2003.

More important, however, the current market is forcing transformation in all major facets of the National Airspace System: aircraft systems, ground and air operations, automation and control, and how transportation modes (e.g., plane, car, truck, rail) come together to maximize the System's efficiency and capacity. The transformation options are complicated, and the implementation risks are high. The Federal government's role in this context will be to enable necessary changes and lessen the negative impacts evidenced by increased restructuring of airlines, disruption of services, and reduction in benefits and stability for airline workers. Dealing effectively with this transformation requires organizations that can provide impartial and multi-faceted capabilities in areas like capacity, safety, and systems research and development, and that can negotiate and co-develop solutions with industry, academia, other government agencies, as well as the international community. NASA is a unique organization capable of meeting these demands.

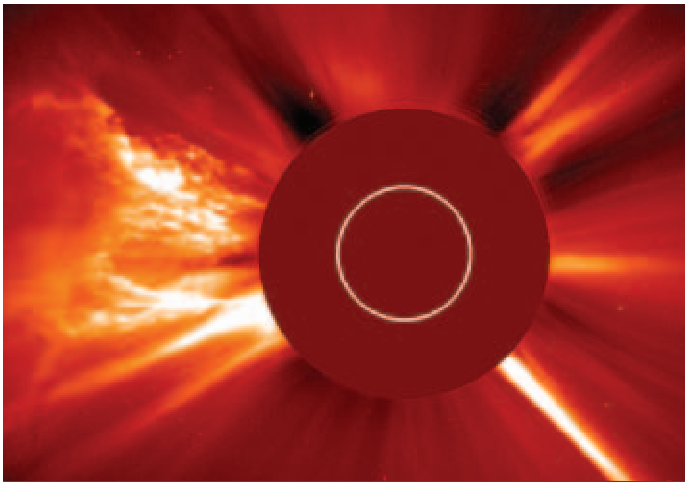
Strategic Objective 13: Use NASA missions and other activities to inspire and motivate the Nation's students and teachers, to engage and educate the public, and to advance the scientific and technological capabilities of the nation.

NASA will continue to inspire and motivate the next generation of explorers through the Agency's visible research, enabling technologies, and exciting discoveries. As noted by the Aldridge Commission, the *Vision for Space Exploration* offers "an extraordinary opportunity to stimulate mathematics, science, and engineering excellence for America's students and teachers." To achieve this goal, education programs are an integral part of every major NASA activity.

NASA has initiated and/or enhanced many activities, including: working with governments, industries, and professional organizations to integrate science, technology, engineering, and mathematics education initiatives, internships, and other activities into training and development programs and outreach initiatives; creating a university-based "virtual space academy" to train the next generation of technical workforce; and fully implementing the NASA Explorer Schools program and the NASA Educator Astronaut program. NASA's Science and Technology Scholarship Program links scholarships with service at NASA Centers to help the Agency attract top students to the workforce, and NASA Explorer Institutes initiative links NASA to the informal education



The Terra satellite imaged this phytoplankton bloom off the coast of Argentina in January 2005. Terra is one of several NASA Earth observation satellites that provide a comprehensive view of Earth's system, from the surface to the upper atmosphere. Additional satellites, including Cloudsat and Calipso, will enhance current observation capabilities.



The SOHO spacecraft imaged three significant coronal mass ejections in late December 2004. Coronal mass ejections bombard Earth with energetic particles, disrupting electronics and communications and exposing astronauts in Earth orbit to higher levels of radiation. NASA is finding ways to better predict space weather and to prepare for violent space weather events that could pose a threat to astronauts in space and technology on Earth.

community—science centers, museums, planetaria, and other organizations. NASA also works actively with industry, professional organizations, and the media to engage the public in understanding why space exploration is vital to America's scientific, economic, and security interests.

NASA also is increasing the priority of, and emphasis on, teacher training by providing for teachers the tools they need today to teach the Nation's researchers and explorers of tomorrow. With its partners, the Agency is creating extraordinary technology enhancements that will make learning more available and exciting for all students, including those with auditory, visual, physical, and intellectual challenges. These technologies will help students, educators, families, and individuals around the world explore new worlds of learning while pursuing their own journeys of personal discovery.

Strategic Objective 14: Advance scientific knowledge of the Earth system through space-based observation, assimilation of new observations, and development and deployment of enabling technologies, systems, and capabilities, including those with the potential to improve future operational systems.

NASA's ability to study Earth from space has given humanity new tools with which to understand and protect their home planet. Having completed the first phase of the Earth Observing System, the Agency is extracting scientific knowledge of the Earth's carbon, water, and energy cycles from the system's data and sharing the information with NASA's partner Federal agencies like the National Oceanic and Atmospheric Administration, the Federal Emergency Management Agency, the Federal Aviation Administration, and the Environmental Protection Agency, enabling them to provide essential services to the Nation.

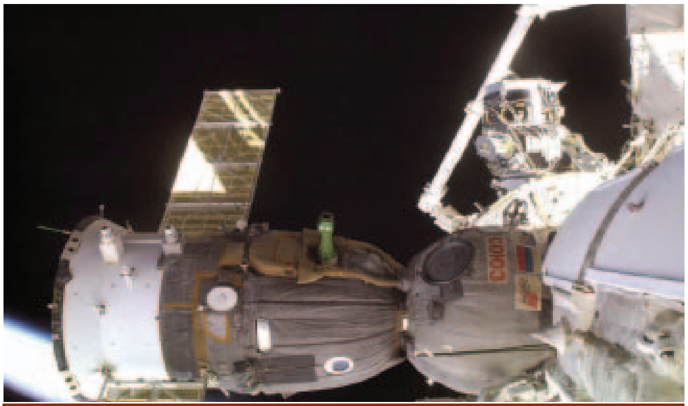
NASA already is moving to develop and deploy the next generation of Earth observing capabilities. In 2005, Cloudsat and CALIPSO will add their innovative three-dimensional view to the existing satellites to form the "A-train" of observers, providing a complete picture of Earth's atmosphere. A new slate of NASA satellites capable of measuring atmospheric carbon dioxide, soil moisture, and ocean surface salinity and topography will be the next wave of climate change research capabilities. Ultimately, NASA and the Agency's partners will create an integrated "sensorweb" of satellites in low, medium, and higher orbits to enhance scientists' abilities to predict climate, weather, and natural hazards. For example, working with the Agency's American and international partners, NASA will develop predictive capabilities within the next 10 years that will enable: 10-year or longer climate forecasts; three-day air quality forecasts for ozone and aerosols; 10- to 100-year forecasts of carbon dioxide and methane concentrations with greater than 50-percent improvement in confidence; seasonal precipitation forecasts with greater than 75-percent accuracy at tens of kilometers of resolution; and seven to 10-day weather forecasts with 75-percent accuracy.

NASA's unique view of the world from space is essential to the continued success of the Climate Change Research program, the Global Earth Observation program. NASA will continue advancing the Nation's use of this view to enhance economic, security, and environmental stewardship and, in so doing, demonstrate techniques for studying a planet in its entirety—techniques that researchers can employ in the future to explore other planetary bodies and conduct the search for life beyond Earth.

Strategic Objective 15: Explore the Sun-Earth system to understand the Sun and its effects on Earth, the solar system, and the space environmental conditions that will be experienced by human explorers, and demonstrate technologies that can improve future operational systems.

Life on Earth prospers in a biosphere sustained by energy from the Sun, but powerful flares and coronal mass ejections arriving at Earth can disrupt telecommunications and navigation, threaten astronauts, damage satellites, and disable electric power grids. As society becomes increasingly dependent on space-based technologies, the vulnerability to space weather effects on Earth, and on other planets, becomes more apparent, and the need to understand and mitigate its effects becomes more urgent. NASA's goal is to understand the causes of space weather by studying the Sun, the heliosphere, and planetary environments as a single, connected system. This will be achieved by pursuing two groups of missions.

The Solar-Terrestrial Probe missions will address fundamental science questions about the physics of space plasmas and the flow of mass and energy through the solar system. For example, Solar–B, a Japanese-led partnership mission, will be launched in 2006 to observe how magnetic fields on the Sun's surface interact with the Sun's outer atmosphere, which extends millions of miles into space. The STEREO mission, also to be launched in 2006, will determine the evolution of solar disturbances from the Sun's surface to Earth's



The blackness of space provides the backdrop for this scene of a Russian Soyuz TMA-4 spacecraft docked to the Station's Zarya functional cargo block nadir port in September 2004. While the Shuttle is grounded, the Russians have delivered crew and cargo to the Station. In the future, a combination of vehicles, including those provided by other international partners and commercial providers, will provide transportation to and from the Station.

orbit. And, the Magnetospheric Multiscale Mission, to be launched in 2011, will explore the fundamental physical processes responsible for the transfer of energy from the solar wind to Earth's magnetosphere and for the explosive release of energy during solar flares.

The Living with a Star missions will enhance scientists' knowledge of Earth–Sun system aspects that directly affect life and society. The Solar Dynamics Observatory, to be launched in 2008, will observe the solar interior and atmosphere continuously to determine the causes of solar variability. The Ionospheric/Thermospheric Mapper, to be launched in 2009, will help scientists understand, ideally to the point of prediction, the effects of geomagnetic storms on the ionosphere/thermosphere, a region in the atmosphere located approximately 53 to 620 miles above Earth's surface. And, the Radiation Belt Mapper, to be launched in 2012, will determine how space plasmas are accelerated to hazardous energies, thereby enabling scientists to predict changes to planetary radiation environments and protect space explorers.

Strategic Objective 16: Pursue opportunities for international participation to support U.S. space exploration goals.

Achieving the *Vision for Space Exploration* requires advanced systems and capabilities that will accelerate the development of many critical technologies, including power, computing, nanotechnology, biotechnology, communications, networking, automation controls and guidance, robotics, and materials. To meet these challenging technology requirements, NASA will invite active participation by the Agency's international and national partners. The resulting technologies will support and advance the space programs, economies, and security interests of the United States and all participating nations.

NASA values and seeks Agency partnerships with international, Federal, state, and local government agencies, industry, and academia that can help the Agency achieve its National Objectives. Humankind will benefit from the cooperation of nations that share expertise and leverage resources to develop space systems and other technologies that address universal scientific, security, and commercial interests.

Strategic Objective 17: Pursue commercial opportunities for providing transportation and other services supporting International Space Station and exploration missions beyond Earth orbit. Separate to the maximum extent practical crew from cargo.

NASA will work with the Agency's partners to create a mixed fleet for International Space Station cargo re-supply. NASA also will seek commercial transport and other services both for the International Space Station and for missions beyond low Earth orbit. In particular, the Agency will seek existing or new commercial launch vehicles to transport cargo to the Station and, potentially, to the Moon and beyond. NASA also anticipates developing a significant number of new partnerships to help design, develop, and demonstrate the Crew Exploration Vehicle.

The Aldridge Commission recommended in its June 2004 report that private industry play a larger role in space operations, particularly in accessing low Earth orbit. Consistent with this recommendation, in September 2004, NASA issued a Request for Information for commercial cargo re-supply and return service providers. The Request for Information solicited information on current and planned space transportation capabilities to identify potential qualified providers. As the next step in the cargo re-supply acquisition process, NASA soon will issue a Request for Proposal.

Strategic Objective 18: Use U.S. commercial space capabilities and services to fulfill NASA requirements to the maximum extent practical and continue to involve, or increase the involvement of, the U.S. private sector in design and development of space systems.

As missions move further into the solar system, NASA will rely more heavily on private sector space capabilities to support exploration activities both in and beyond Earth orbit. In addition to tapping creative thinking within NASA, the Agency also will develop ways to solicit and leverage the ideas and expertise of the Nation's universities and non-profit organizations. For example, this year NASA will implement the full Centennial Challenges program which will establish and present prizes for specific accomplishments that advance solar system exploration and other NASA goals. NASA will continue working with government, industry, and academic partners to identify and achieve common research objectives and mutual goals. And, NASA will couple its technology with private sector technology, where possible, by establishing joint agreements and collaborations to mature technologies and transfer them to the commercial sector where they can benefit the public.

The Vision is Transforming NASA

NASA controllers monitor Station activities in the Station Flight Control Room at Johnson Space Center's Mission Control Center in October 2004.

The Vision is Transforming NASA

Implementing the *Vision for Space Exploration* requires a lead agency that can manage interdependencies and linkages between organizational units, focus and prioritize diverse activities, and integrate space science robotics programs with future human missions to the Moon, Mars, and beyond. NASA rapidly is becoming that kind of organization through a variety of transformation initiatives. Transformation is a long-term, continual process. Therefore, NASA has established three "optimal states," targets to guide the Agency on this journey.

- **Technical Excellence:** NASA safely and consistently meets mission objectives through relentless technical rigor and sound program and project management practices. The Agency also plans strategically, manages resources effectively, and collaborates to ensure that the right people have the right resources at the right times to execute the mission.
- **Organizational Excellence:** NASA balances rigor with flexibility and innovation in its organizational and business practices to ensure mission success and alignment with Agency core values. It also engages the American people to understand the relevance and value of its work to their general welfare.
- **People Excellence:** NASA employs a high-performing workforce and a cadre of exceptional leaders that are committed to NASA's vision and mission, consistently live Agency core values, and remain adaptable to an ever-changing environment. NASA also fosters an inclusive culture in which all members of the NASA family communicate openly, feel valued, and are empowered to ensure mission success.

Transforming NASA's Organization Structure

NASA's organizational transformation is off to a strong start. As of August 2004, NASA has four Mission Directorates—Exploration Systems, Space Operations, Science, and Aeronautics Research—and eight Mission Support Offices, including the Office of Education and the Office of Safety and Mission Assurance. The Agency's transformed structure includes a Strategic Planning Council and a supporting Office of Advanced Planning and Integration to enable better long-range planning, an Operations Council to integrate NASA's tactical and operational decisions, and a number of new or reconstituted committees that support NASA's focus and direction. Responding to a key Aldridge Commission report recommendation, NASA also is reviewing possible alternate organization models for the Agency's Centers.

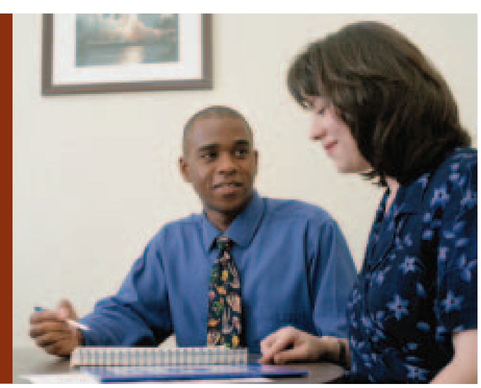
Advanced Planning and the Road to the Agency's Strategic Architecture

NASA is focused on achieving the *Vision for Space Exploration*, and the organization's transformation includes new initiatives to improve communication among the Mission Directorates for effective project integration. One such key initiative is "roadmapping," developing specific courses of direction to guide the Agency's achievement of the *Vision for Space Exploration*. NASA is developing both strategic roadmaps and capability roadmaps for release in late 2005.

The strategic roadmaps will ensure that NASA's organization remains aligned and integrated as the Agency pursues the *Vision for Space Exploration* and the five National Objectives. Capability roadmaps will guide development of identified enabling technologies critical to attaining NASA's Strategic Objectives. They will include initial technology assessments, plans to develop and integrate mature technologies into the exploration architecture, and a strategy to transition appropriate technologies to the private sector.

Thirteen teams of nationally recognized scientists, engineers, educators, visionaries, and managers, working with NASA personnel and other government agencies, are developing the Agency's strategic roadmaps. In concert with this activity, 15 teams of subject matter experts are crafting supporting capability roadmaps. Together, the strategic and capability roadmaps will be integrated into NASA's Strategic Architecture, a NASA-wide framework for prioritizing and implementing program initiatives that will encompass the technical aspects of NASA's mission, as well as the workforce, institutional, facilities, and policy implications. This architecture will serve as a system of checks and balances for informed decision-making while providing a healthy, dynamic tension between long-term strategic and near-term tactical considerations. (For more information, visit *www.nasa.gov/about/strategic_roadmaps.html*.)

NASA's staff are critical to the overall success of the orgination and its goals. The Agency values professionalism, diversity, and personal growth among its staff and fosters teamwork, fairness, and respect.



Moving Toward One NASA

The concept of One NASA means that the Agency will operate as a single team and apply its unique capabilities to the pursuit of NASA's shared mission and the *Vision for Space Exploration*. The One NASA initiative enables better decision-making, enhanced collaboration, better leveraging of resources, decreased overlap and redundancies, and greater standardization to achieve efficiencies. It will move NASA toward the Agency's three optimal states by contributing to excellence in all areas, and it will promote sustainability by embedding these improvements permanently in NASA's culture. Through the One NASA initiative, NASA will accomplish together what no single organizational element could achieve alone.

Implementing the President's Management Agenda

In 2004, Office of Personnel Management Director Kay Coles James and Office of Management and Budget Deputy Director Clay Johnson, III, honored NASA as the first Federal agency to achieve the highest standards of excellence ("Green") in two of the original five government-wide President's Management Agenda (PMA) initiatives: (1) Strategic Management of Human Capital, and (2) Budget and Performance Integration. NASA also achieved "Green" in the PMA initiative of E-government. NASA's goal is to achieve "Green" ratings in all PMA initiatives within three to four years.

Assessing NASA's Core Competencies

In 2005, NASA's senior leaders are developing a set of Agency core competencies based on early assessments of the challenges ahead—key knowledge, skills, and capabilities that must reside within NASA if the Agency is to achieve its objectives. They will assign specific competencies to each NASA Center with as little overlap as possible. These competencies will be reviewed and adjusted periodically, with the first review occurring in late 2005 when the strategic and capability roadmaps are complete.

Embedding a Safety Culture

The *Columbia* Accident Investigation Board report cited two causes of the *Columbia* accident, one "physical" (the sequence of events on Shuttle Mission STS-107 that destroyed the orbiter), and the other "organizational" (the failures within NASA that allowed those events to occur). NASA is committed to creating a "safety culture" that addresses all of the Board's concerns.

Safety is NASA's first priority and a core Agency value. The plan for culture change starts with instilling safety-first behaviors throughout the organization beginning with the Agency's current senior leaders. This approach will establish a foundation for sustaining the safety culture even as leadership changes. Continuing culture-change initiatives include team effectiveness training at all levels of NASA, updating NASA-sponsored leadership and management development

In a ceremony held in April 2004, Office of Personnel Management Director Kay Coles James presented NASA Administrator Sean O'Keefe with a Kermit the Frog doll (left) in recognition of NASA achieving a "Green" rating for its progress in the PMA area of Human Capital. In return, O'Keefe presented James with a plaque of appreciation from NASA. Credit: R. Bouchard.

programs, and measuring organizational change through survey instruments.

Ensuring Freedom to Manage

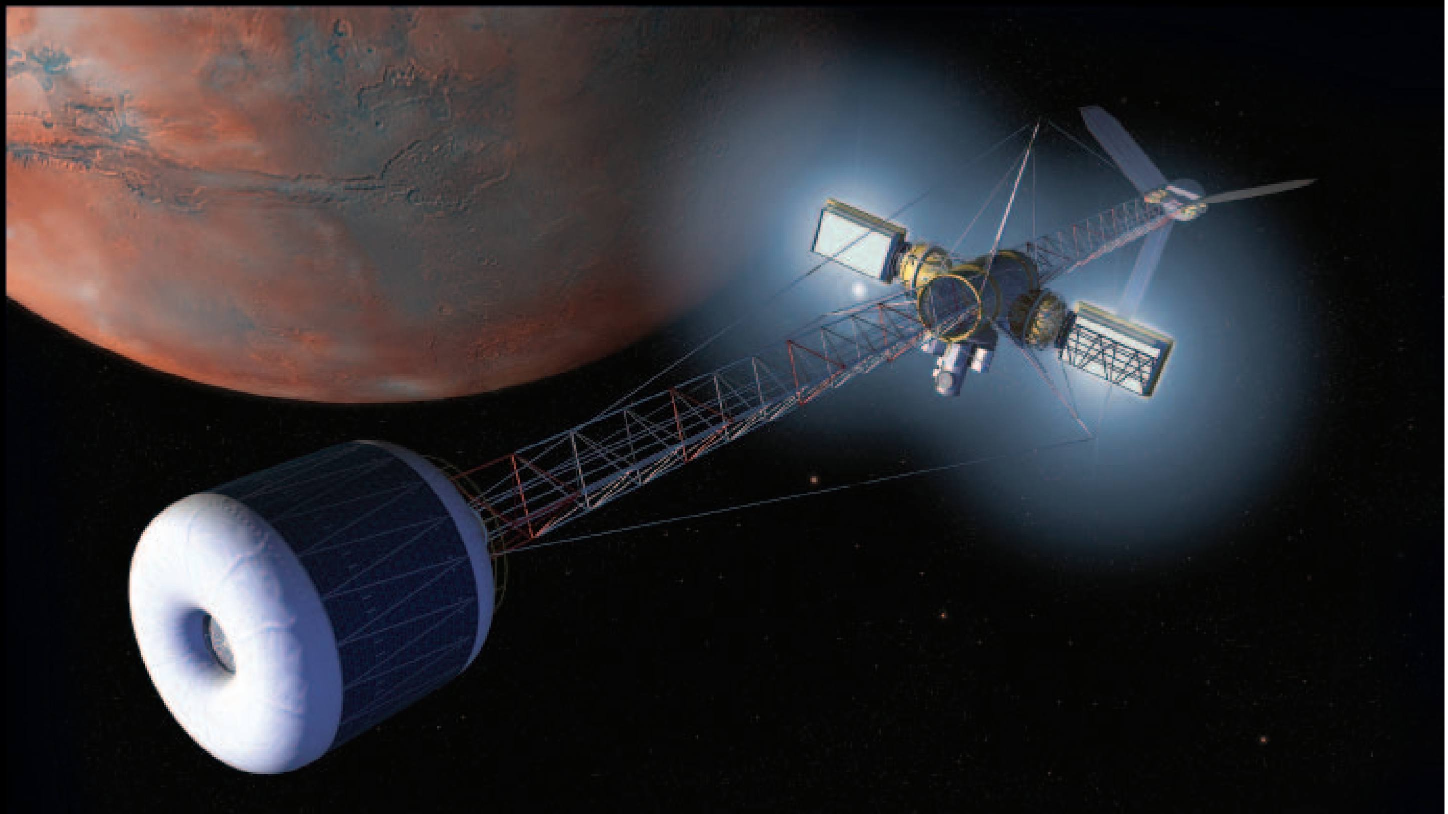
In 2002, NASA created the Freedom to Manage Task Force to identify internal and external impediments to effective management and recommend changes that would eliminate or minimize them. The Task Force considered externally imposed legislation and regulations and internally imposed policies and practices that limit managers' abilities to act responsibly. The Task Force also considered existing and non-existing authorities that, if put in place, would enable better management. The Task Force currently is moving a number of proposals toward enactment to ensure that the remaining impediments to management excellence receive the Agency's full attention.

Legislative Achievements in 2004

Numerous legislative proposals ultimately emerged from the Freedom to Manage Task Force last year, including passage of the NASA Workforce Flexibility Act of 2004. This Act gives the Agency exciting new tools and flexibilities with which to attract and retain a world-class workforce.

Continuing the Journey

NASA's future, and the future of America's space program, is as bright as the sun itself. For 46 years, NASA and its predecessor Agency have not wavered in their commitment to reach for and beyond the planets and the stars to better life on Earth for all humankind. NASA has the spirit, commitment, and energy to achieve the *Vision for Space Exploration*. The Agency will continue the journey to the future, as pledged to comrades lost and as promised to the explorers of tomorrow.



"This cause of exploration and discovery is not an option we choose;

It is a desire written in the human heart."

President George W. Bush
February 4, 2003

For more information or additional copies, please send an email to public-inquiries@hq.nasa.gov.

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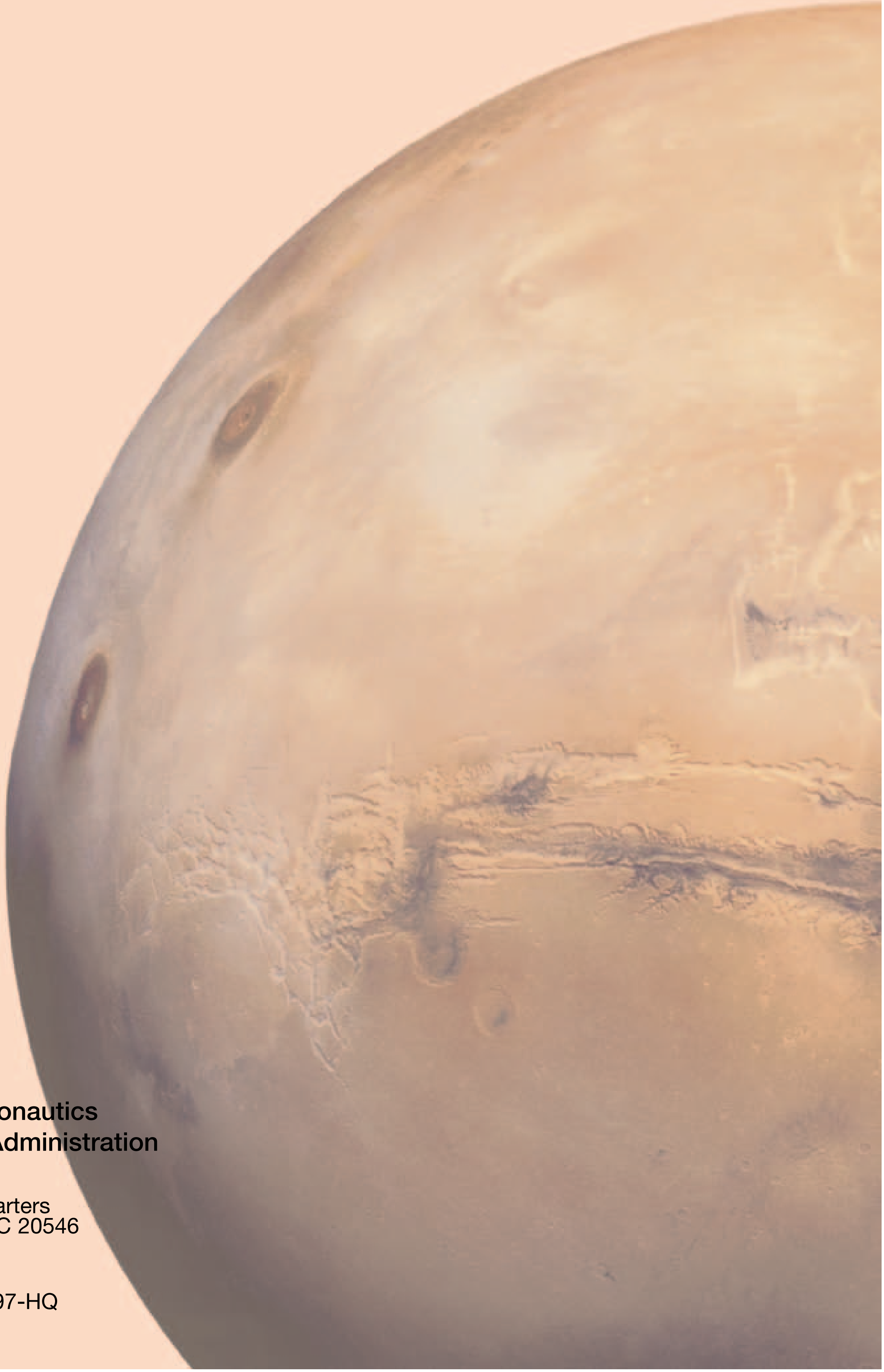
Above: A spacecraft, equipped with a centrifuge and nuclear–electric propulsion, travels to Mars in this artist's concept of future human space exploration. Credit: John Frassanito and Associates.



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